TEST REPORT

O100185-159292

18/11/2021

Test of the impact of a splash guard on the amount of stone chips

Villaägarnas Riksförbund Product Review

Date
19/11/2021

Our reference
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SUMMARY

For the stone chip test, a test rig was set up to mimic the wheels and wheel housing of a Volvo XC60. Gravel for road sanding was fed between the wheels of the test rig to determine to what degree stone chips were caused ten meters away on a stand covered with kraft paper. The stand was 0.4 m wide and 1.5 m tall and divided into five 0.3-m tall compartments.

The number and traveling distance of the stone chips depend on the driving speed, tyre pressure and how the gravel "penetrates" the tyre pattern of the upper wheels of the test rig. An uncertainty in the method includes that there is variation in size, density and shape of the gravel and how it 'feeds in' between the wheels. If at each reading a mark is misread, this gives an uncertainty of three stone chips over three samples. Taken together, this means that one should be cautious about drawing conclusions if the differences are less than four stone chips.

The test showed that:

- The number of stone chips increased with a higher driving speed.
- The higher the driving speed, the more gravel is projected from the road surface.
- Splash guards significantly reduce the amount of stone chips. During the test at a driving speed of 100 km/h the number of stone chips dropped from 53 without a splash guard to 29 with a splash guard.
- The risk of stone chips decreased significantly with increasing distance. It could thus be concluded that the risk of stone chips can be significantly reduced by keeping a longer distance to the vehicle in front.
- Some stones penetrated the kraft paper at a distance of 10 m while others only made marks on the kraft paper. A higher kinetic energy increased the risk of a stone puncturing the kraft paper.

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TEST OF THE IMPACT OF A SPLASH GUARD ON THE AMOUNT OF STONE CHIPS

Performed by: RISE SMP Svensk Maskinprovning AB
Box 4053, SE-904 03 Umeå

Client: Villaägarnas Riksförbund Product Review
PO Box 7118
SE-192 07 Sollentuna

Contact (client): Ulf Stenberg

The project was carried out: 01/09/2021 – 05/11/2021

Ordered test: Test of the impact of a splash guard on the amount of stone chips.

Performed work:
A. Construction of a test rig
B. Comparison at three different driving speeds
C. Comparison with and without splash guards

Appendix: Appendix 1. Sieve analysis of the gravel

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INTRODUCTION

As commissioned by Villaägarna Product Review, RISE SMP Svensk Maskinprovning AB has carried out a test of the impact of the splash guard on the amount of stone chips.

The test was carried out at RISE SMP Svensk Maskinprovning AB's test facility in Umeå.

TEST RIG

The test rig (Figure 1) consisted of two wheels mounted against each other. The lower wheel (a used tyre, Falken FK452 265/35 ZR18, 5-mm tread depth) was driven with a variable motor speed to simulate different driving speeds. The wheel housing including the bumper was constructed to imitate a common passenger car on the Swedish market: the Volvo XC60. The upper wheel (new tyre, Gislaved Softfrost 225/40 R18T XL 8-mm tread depth) was given a load of 4900 N (500 kg) through a hydraulic cylinder to simulate regular wheel load. The hopper was filled with about 2 kg of gravel. During the test, the speed of the lower wheel was set to correspond to three driving speeds of 60 km/h, 80 km/h or 100 km/h. The hopper was then opened and the gravel traveled down the slot to the contact surface between the wheels.

Figure 1. Test rig for generating stone chips. Shown here without a splash guard.

The gravel projected from the wheels was detected on a piece of kraft paper attached to a 1.5-m tall stand divided into five compartments corresponding to various heights above the road surface (Figure 2).
Each compartment measured 30 cm in height and 40 cm in width. The height of the stand corresponds approximately to the height of a passenger car and the width of the stand to one fifth of the width of a passenger car.
After each test run, all the stone chips on the kraft paper were recorded in order to be summed up (Figure 3). Both stones that punctured the kraft paper and ones that only made marks on it were recorded as stone chips.

The gravel used in the tests was purchased from SVEVIA in Umeå and corresponds to the anti-skid treatment used on our roads. See Appendix 1 for a typical sieve analysis.

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Figure 2. Kraft paper mounted on the stand for stone chip detection.

Figure 3. Appearance of the kraft paper after three test runs.

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IMPLEMENTATION

The study started by placing the stand 17 m behind the contact surface between the wheels (Figure 4). As hardly any stone chips occurred at a driving speed of 100 km/h and a distance of 17 m, the decision was made to move the stand to a distance of 10 m from the contact surface between the wheels.

Test without a splash guard

Three test runs were carried out at driving speeds of 60 km/h, 80 km/h and 100 km/h. A summary of the combined observations for each driving speed is presented in Table 1 and in Figure 5.

Figure 4. Test set-up with the stand placed 17 m from the wheels' contact point.

Compartment	Height above the road (cm)	Distance (m)	Number of stone chips 60 km/h	Number of stone chips 80 km/h	Number of stone chips 100 km/h
5	120-150	10	0	4	6
4	90-120	10	6	3	9
3	60-90	10	7	8	12
2	30-60	10	4	6	8
1	0-30	10	10	14	18
In total	0-150	10	27	35	53

Table 1. Summary of results for samples without a splash guard. The total number of stone chips from the three test runs at 60 km/h, 80 km/h and 100 km/h.

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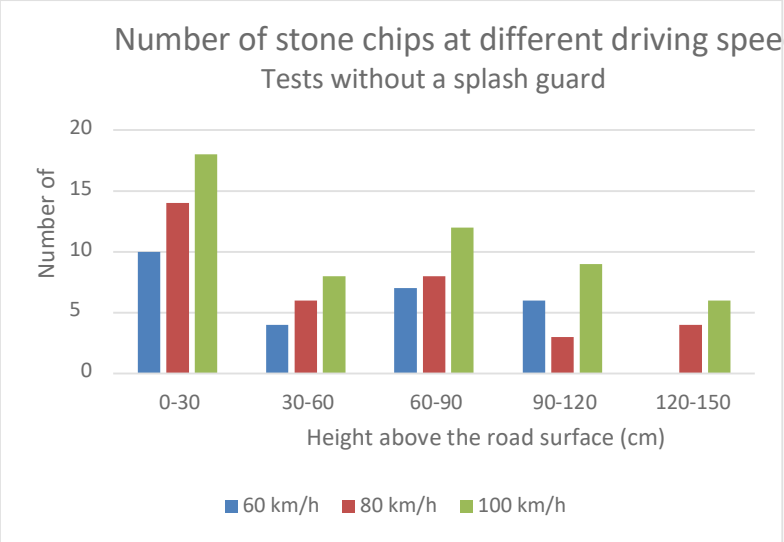

Figure 5. Number of stone chips during tests without a splash guard at three different driving speeds.

Tests with a splash guard
Subsequently, a standard splash guard was then installed (original accessories, Figures 6 and 7, dimensions in Figure 8). Three test runs were carried out at a driving speed of 100 km/h which was the driving speed that produced the highest number of stone chips.

A comparison of runs with and without splash guards is presented in Table 2 and Figure 9.

Figure 6. Original splash guard model installed, side view.

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Figure 7. Original splash guard model installed. Rear view.

Figure 8. Measurements without and with original splash guard.

Compartment	Height above the road surface (cm)	Distance (m)	Number of stone chips without a splash guard	Number of stone chips with a splash guard
5	120-150	10	6	2
4	90-120	10	9	3
3	60-90	10	12	6
2	30-60	10	8	10
1	0-30	10	18	8
In total	0-150	10	53	29

Table 2. Summary of results for tests with and without splash guards at a driving speed of 100 km/h. 53 stone chips without a splash guard reduced to 29 stone chips with a splash guard.

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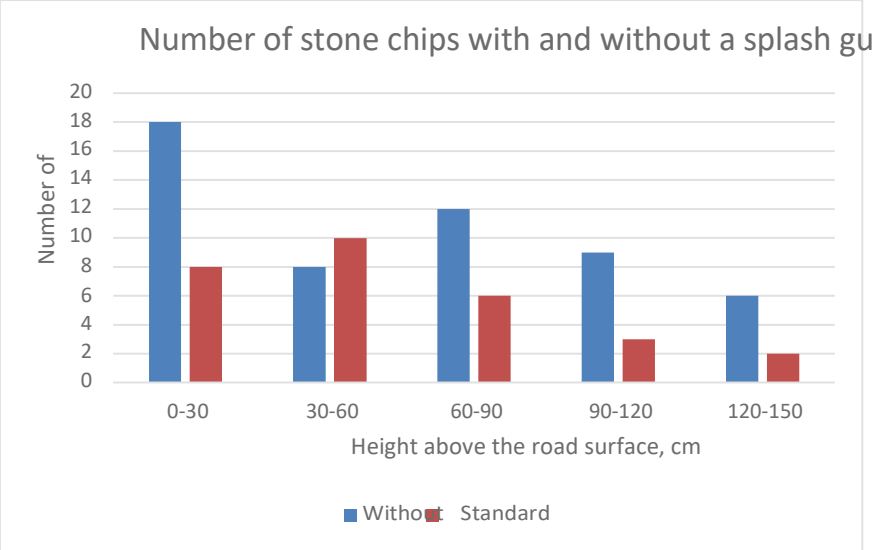

Figure 9. Number of stone chips with and without a splash guard at different heights above the road surface at a driving speed of 100 km/h.

A longer distance to the vehicle in front reduces the risk of stone chips.
The test area was swept clean before the test runs. After all the runs, the gravel was collected from four different zones, 5-10 m, 10-15 m, 15-20 m and 20-25 m, and the results are presented in Table 4 and Figure 10.
The collected gravel also includes the amount that did not reach the level of the intended "roadway".
Within the distance 0-5 m it was uncertain whether there was also gravel that had passed under the fictitious "roadway" even if the test rig was built to prevent this.

Distance (m)	Weight (g)	%
20-25	57	1.7
15-20	429	12.8
10-15	724	21.5
5-10	2149	64.0
In total	3359	100.0

Table 3. Summary of the amount of gravel collected after all the test runs at different distances (zones) from the contact surface between the wheels.

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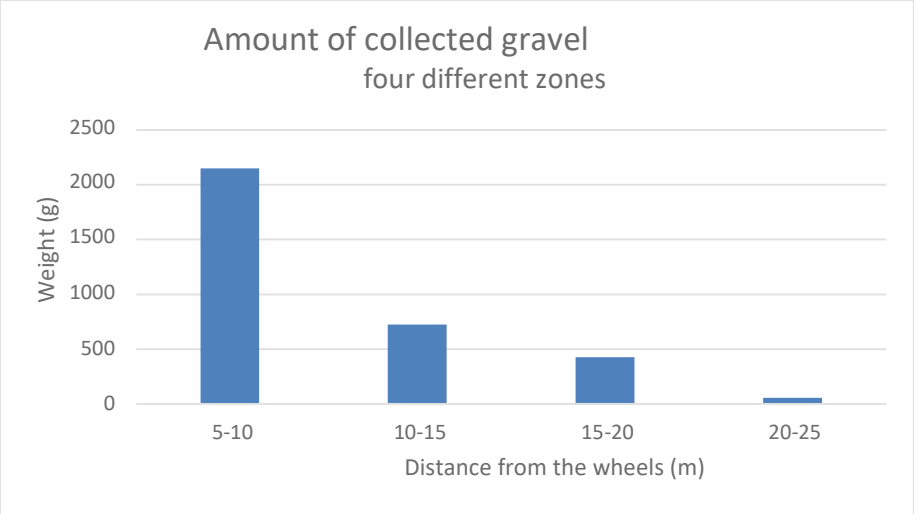

Figure 10. Amount of gravel collected after all test runs at different distances (zones) from the contact surface between the wheels.

The amount of gravel that was collected decreased with the distance from the test rig. It could thus be concluded that the risk of stone chips can be significantly reduced by keeping a longer distance to the vehicle in front.

RISE SMP Svensk Maskinprovning AB
Machine safety, Umeå

Stefan Frisk
Head of Unit, Machine Safety

Hans Arvidsson
Test Manager

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APPENDIX 1.

SIEVE ANALYSIS OF THE GRAVEL

SVEVIA

SWEDAC ACKREDITERING
Ackred. nr. 1999
Provning
ISO/IEC 17025

RAPPOR
utfärdat av a
TEST REPORT i

ANALYS Stenmaterial

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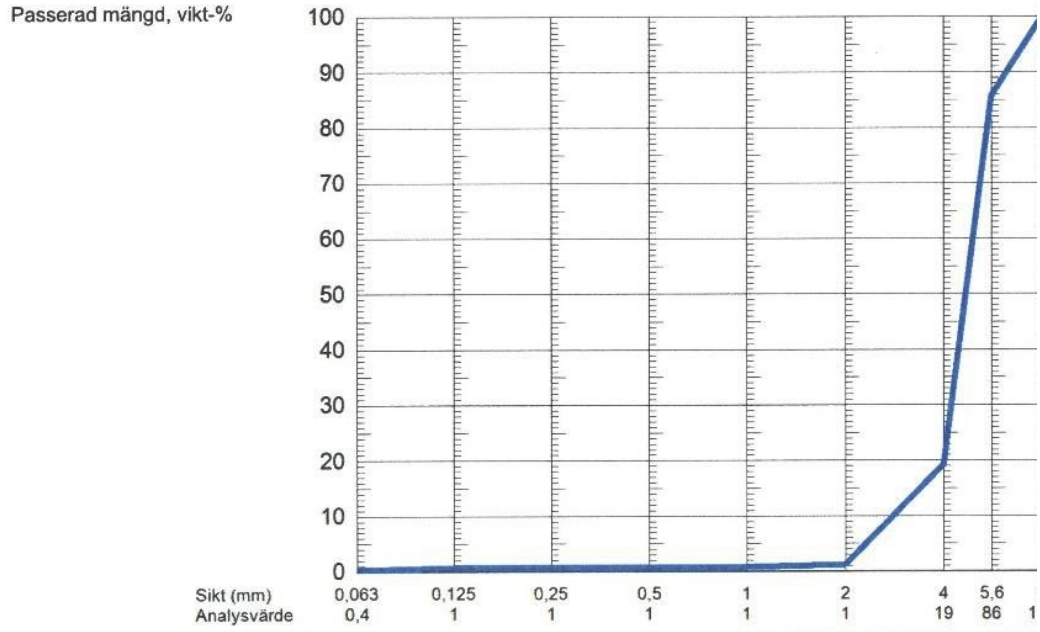
Gränslinje
Acceptanskrav



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Tvättning och siktning